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**Archaeological
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PRIMITIVE AEGEAN ROOFS

It is a refreshing commentary on the energy and ingenuity of the human mind,—and also perhaps upon its inconclusiveness,—that after the long series of attempts to reconstruct the primitive Doric frieze, it should still be possible to advance a new, or at least a novel, restoration. Such a restoration, quite different from anything proposed in modern times, was recently presented by Professor Washburn[1] in this Journal. The subject can hardly be definitely settled until every possible restoration shall have been presented, but in the meantime it is worth while giving careful criticism to all that are suggested, to determine which seem within the limits of probability. I, therefore, desire to point out certain respects in which Washburn's premises and conclusions appear to me to be unsound.

The kernel of his new theory is that the *metopes* of the Doric frieze, in stone architecture, represent the ends of horizontal beams used in an earlier flat-roof architecture of wood and clay, and Washburn prefaces his reconstruction with the statement that "it will not be possible to settle definitely the question of flat roof versus pitched roof."[2]

In classic times, as far back as we have any evidence, the Doric roof is known to have been a pitched roof, while the pre-Doric Mycenaean roof is generally supposed to have been flat.[3] Washburn assumes that one was derived from the other and that the details of the Doric frieze were developed after Mycenaean times but before the roof began to slope.

Now as it has been apparently impossible to trace any continued development from Mycenaean to Dorian culture in the other arts,—pottery, ornament, costume, etc.,—the *a priori* assumption, quite commonly made, that there is a developmental connection between the architecture of the two civilizations is open to serious question. And unless there is a reasonable assurance that the Doric roof was once flat, it seems rather futile to base the details of a reconstruction on that assumption.

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[1] *A. J. A.* XXIII, 1919, pp. 33–49.

[2] *Op. cit.* p. 42.

[3] Leroux, *Les origines de l'edifice hypostyle* (*Bibl. des écoles fr. d'Athènes et de Rome.* fasc. 108) Paris, 1913, maintains that the Mycenaean megara had pitched roofs (pp. 51–70).

As a matter of fact the question of the different roof-constructions of primitive architecture is by no means incapable of settlement. In most cases the plan of a building indicates very clearly the general type of roof that covered it. The roofs of the prehellenic Mediterranean have already been most fully and intelligently discussed by Leroux.[1] Mackenzie,[2] in reviewing the same ground, has arrived at somewhat different theories. Neither the one nor the other is correct in all points, but both have shown that the problem is not one to be abandoned as altogether hopeless.

If we consider primarily roof constructions in which timber is used, and exclude, therefore, beehive tombs and the like, a brief survey of known primitive architecture throughout the world shows us three distinct types. The first is that in which poles are firmly planted in the earth at their lower ends and being fastened to one another at the top in the form of a cone are supported there by mutual thrust alone. This is the type of our American Indian *tepees.* Where the space to be covered is great and the stiffness of the poles available is relatively slight, the latter are bowed upwards to prevent them from sagging under the weight of the roof covering,—thatch, felt, skins, matting, etc.,—producing a domical hut. This is the type found in American *wigwams*, in the "*kibitkas*" of the nomads of the Asiatic steppes, in the grass huts of Africa,[3] and generally in primitive round houses the world over.[4] Such a roof construction is naturally expressed by a circular plan, and conversely circular plans naturally indicate this roof construction. I know of no people who habitually cover a circular plan with a flat roof. Therefore it is quite probable that this type of roof originally covered many, if not all of the prehistoric circular foundations recently uncovered in Greece.[5]

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[1] *Op. cit.*

[2] 'Cretan Palaces and the Aegean Civilization,' particularly Pt. IV, *B. S. A.* XIV, 1907–08, pp. 343 ff.

[3] This type and the other two hereafter described are all well exemplified in Africa. Cf. Ankermann, *Anthropos*, I, 1906, pp. 581–584.

[4] Innocent, *The Development of English Building Construction*, p. 8, describes similar conical huts built by charcoal burners in England, Sweden, France, and Germany. These are covered with brush or with sods laid face in. The sods are in some cases lapped like tiles.

[5] At Orchomenos, Bulle, *Orchomenos*, I, pp. 19 ff.; at Eleusis, 'Αρχ.'Εφ. 1898, pp. 29 ff.; Pfuhl, *Ath. Mitt.* 1905, pp. 331 ff.; Poulson, *Dipylongräber*, pp. 14 ff.

In some of the African constructions a central post is used to support the upper ends of the rafters,[1] which in such case are rigid, but this is a comparatively rare construction. So far as I know there is no evidence of a central support in any of the Greek round houses.

In its most primitive form the entrance to a round hoop-roofed house is merely a hole in the thatch with a flap of skin or felt to cover it. But before long this entrance is given a definite form by carrying the thatch of the dome out to an upright hoop planted in front of it (Fig. 1). This vertical entrance-gable obviously gives much better protection from the weather than the sloping hole in the domical hut. But evolution did not stop there; the hoops in front of the opening were soon multiplied,—a light ridge lashed *upon* them where the poles, bent over from both sides, crossed at the top, serving to keep the hoops properly spaced,—and the house with a horseshoe shaped plan was formed.

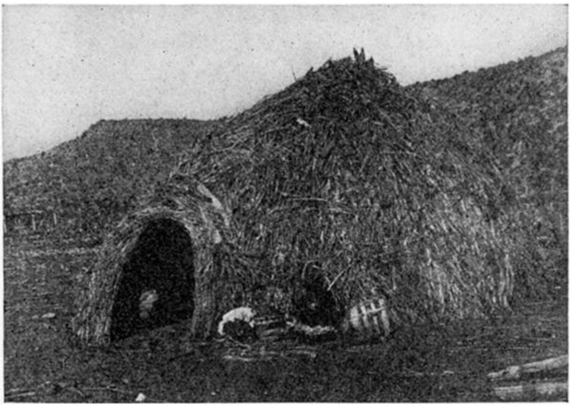

FIGURE 1.—PRIMITIVE APACHE HOUSE.

The foundations of this shape uncovered at Olympia,[2] Orchomenos,[3] Chalandriani,[4] Rakhmani[5] and Rini[6] could hardly have had other than hoop roofs. There is no trace of any support for

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[1] Ankermann, *op. cit.* A centre pole is also used in the larger huts of European charcoal burners, Innocent, *op. cit.*, p. 11.

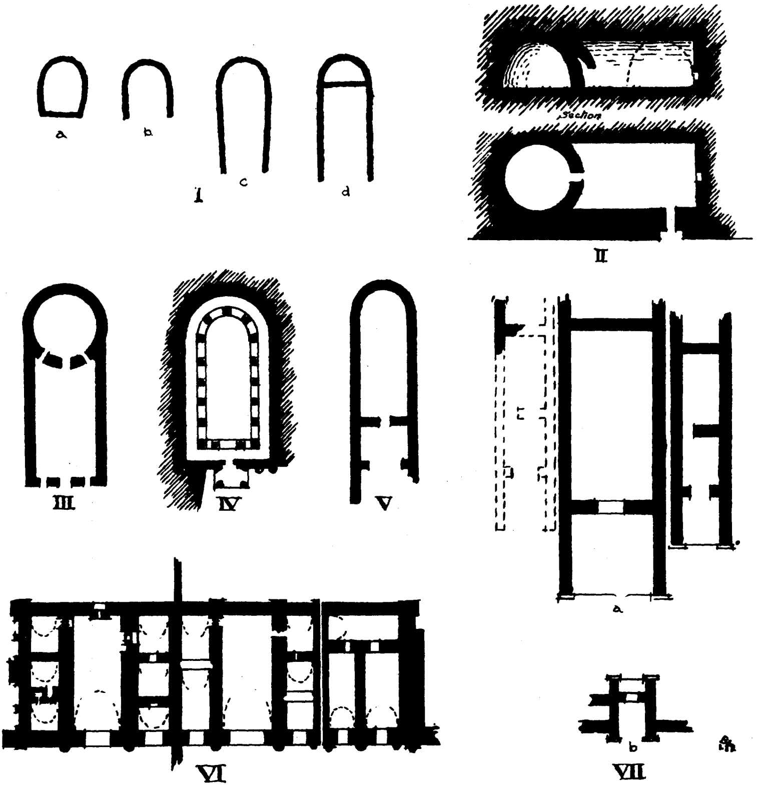
[2] Dorpfeld, *Ath. Mitt.* 1908, pp. 185 ff.

[3] Bulle, *op. cit.* pp. 34 ff.

[4] 'Αρχ. 'Εφ. 1899, pp. 118 ff.

[5] Wace-Thompson, *Prehistoric Thessaly*, pp. 37 ff., fig. 17.

[6] *Ibid.* pp. 132 ff., fig. 80.



Typical Hoop Roof Structures
Various Scales

FIGURE 2.—I, HOUSE FOUNDATIONS, OLYMPIA, GREECE: II, CAVE, BEHAR, INDIA; SECTION AND PLAN: III, VILLAGE CHAITYA-HOUSE, INDIA: IV, ROCK-CUT CHAITYA (19), AJANTÂ, INDIA: V, ROCK-CUT CHAITYA, DHUMNAR, INDIA: VI, PALACE AT HATRA, MESOPOTAMIA: VII, PALACE AT TROY; A, GREAT HALLS; B, PROPYLAEUM.

a ridge-pole, the long apsidal-ended structures of Olympia lacking even a front wall (Fig. 2, I). It is not at all likely that the side walls were arched across with a masonry or brick vault.

From the horseshoe-shaped plan it is only a short step to that in which the side walls are parallel. But since in the latter form the height of the roof is of course constant, it is necessary to fill in the upper part of the entrance end with some sort of a framework to reduce the size of the opening, or else to close it with a wall in which a door is left. And there is nothing to prevent using such a wall to close both ends of the tunnel, giving an elongated rectangle in plan. This latter scheme is naturally suggested where a wall is used to close the front, but where no masonry enters into the construction, it is simpler and more efficient to carry the hoop-roof construction unbroken around a semi-circular rear end.

Hoop roof construction is admirably exemplified in the early architecture of India (Fig. 2. II, III, IV, V). It is clearly shown on the Bharhut sculptures,[1] where in some cases the ends of the houses are curved in plan and in other cases rectangular, and is accurately reproduced in stone in the rock temples of Kârlê and Ajantâ (Fig. 3).[2] It is not impossible that the flexibility of such a roof gave rise to the horseshoe arch of Mohammedan art[3] or that the original domed hut of Mesopotamia[4] was merely a wigwam thickly covered over with clay.[5] And the barrel-vaulted structures of Sassanian architecture recall sharply the close relationship of the

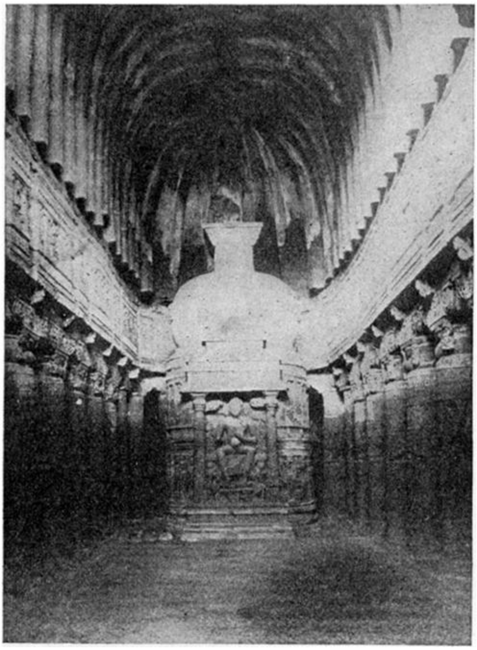


FIGURE 3.—INTERIOR OF CHAITYA HOUSE XXVI: AJANTÂ.

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[1] Havell, *Ancient and Mediaeval Arch. of India.* pls. IV, A; IX, A.

[2] *Ibid.* pls. XVIII, XIX, XLVIII.

[3] Cf. Rivoira, *Architettura Musulmana*, pp. 113 ff.

[4] Layard, *Monuments of Nineveh,* 2nd ser. pl. 16. Plates 24, 36, and 50 show walled towns in which the houses have flexible domed roofs supported by central and diagonal struts, much as the ribs distend an umbrella.

[5] In the so-called "Tombs of the Giants" in Sardinia the stone slabs which serve as façades seem to represent a hoop fastened at the lower ends and tied

Iranians and the Aryans (Fig. 2, VI).[1] But I am not at all convinced that this curvilinear construction is in any way connected with cave dwellings as Leroux suggests[2] or with the beehive tombs. The latter probably originated as a mound of earth or a cairn built over a grave, the coffin being later enlarged to form a chamber. This same scheme is shown in the tumuli of Etruria[3] and the pyramids of Egypt, which certainly developed quite independently of the domestic architecture of the living.

In prehellenic architecture most notable examples of these long barrel roofs, like the tops of prairie wagons, must have covered the great halls of Troy II (Fig. 2, VII). Leroux[4] points out that the narrow space which separates the lateral walls of one from another is certain indication that the roofs were not flat, but drained to both sides. Furthermore, the size of the largest hall (10 m. x 20 m.) with no trace of interior supports, would make a flat roof impossible. For the same reason a roof construction resting on a ridge pole would be impracticable without the use of trusses, which were certainly not known at that time. The only reasonable construction there is one in which the roof members were arched across to the middle from both sides, their butts being planted in the earth or thrusting against heavy and probably not very high side walls.[5]

The second type of roof is that in which flat beams are laid horizontally on the tops of vertical walls and the whole then cov-

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across horizontally at mid-height to prevent undue spreading as in the English "cruck" roof construction. In reality as Mackenzie has clearly shown (*B. S. R. V*, pp. 89 ff.) these structures are developments of the megalithic dolmen, the carving of the façade stone recalling the horizontal roof of the dolmen and the facing of stone upon the mound of earth that covered it. There is no connection here with any frame construction.

[1] A distinct form of hoop roof, with the hoops—called "crucks" or "siles" —held in by tie beams, as in a truss, has even persisted until modern times in England. The "crucks" are curved but rigid and the ends of the buildings are square. (Innocent, *op. cit.*).

[2] *Op. cit.* pp. 19 ff.

[3] Cf. Dennis, *Cities and Cemeteries of Etruria*, 2nd ed., Vol. I, p. lxix, note Q, and p. 387. The architectural decorations of Etruscan and Mycenaean tombs are only a late addition reflected from the architecture of the living.

[4] *Op. cit.* p. 54.

[5] The hoop-roof nave of the rock-cut Chaitya house at Kârlê has a clear span of 7.5 m. (Ferguson, *Hist. of Arch.* III, p. 117.) This is certainly an accurate copy of contemporary wooden structures, which not being rock-cut were probably somewhat larger.

ered thickly with brush and clay. The earliest habitations thus formed were probably partially or wholly excavated in the side of a hill; the roof, level with the upper ground or nearly so, serving to form an artificial cavern of the whole.[1] The plan is naturally rectangular. This is the type of structure used by the Indians of our southwest. It may easily have been originated by cliff-dwelling folk; it is not necessarily older or younger than the curvilinear, sloping roof type, for neither one seems to develop from the other, but it marks a distinct difference in the civilization employing it. The rectangular flat-roof is a permanent structure and belongs to a fixed habit of life, while the round, demountable, sloping roof bespeaks a nomadic or semi-nomadic origin (Fig. 4).[2]

It is evident that whereas in an oblong structure with a hoop-roof the entrance is almost necessarily at one end,[3] in a flat roof structure it may be on any side. It is also evident that if such a dwelling be partially excavated, it will be easier to stretch it along rather than to drive it deep into the side of a hill. And in such cases the flat roofed house naturally has the poles which compose its roof laid from front to rear, instead of from side to side across the longer span.[4] The hooped roof house may increase in length with ease, but great width is a very difficult matter; in the flat roof house, however, the width can be increased easily, and a single large transverse beam or girder makes it possible to double

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[1] As in the winter *iglus* of the Esquimaux. It is interesting to note that the permanent winter houses of these people are rectangular with flat or "ridge pole" roofs, while the temporary summer tents are conical "tepee" structures. Cf. Murdock, *Ethnological Results of the Point Barrow Expedition.* pp. 72–78 and 83–86.

[2] Cf. Mackenzie, *B. S. A.* XIV, 1907–08, p. 356, and above, note 2. It might be supposed that the form of roof would be dependent on the climate or the available building materials. The existence of the hoop roof huts of the vagrant Apaches alongside of the flat roof settlements of the Pueblo Indians indicates that culture is more important than climate or materials.

[3] In the Bharhut sculptures houses are shown which are oblong in plan, rounded at both ends, and with a door at the side. Similar primitive houses have been found in western Europe (Innocent, *op. cit.* p. 12). This type may be due merely to the awkwardness of a door in a curved end, or, quite possibly, is derived from two huts of horseshoe plan set face to face for mutual protection, as shown on the relief of Nineveh (Layard, *op. cit.*). This type, however, is unusual.

[4] As in the ancient structures of Mitla, where the entrance façades are always the long sides. Cf. Holmes, *Archaeological Studies among the Ancient Cities of Mexico*; add also Fig. 4 X.

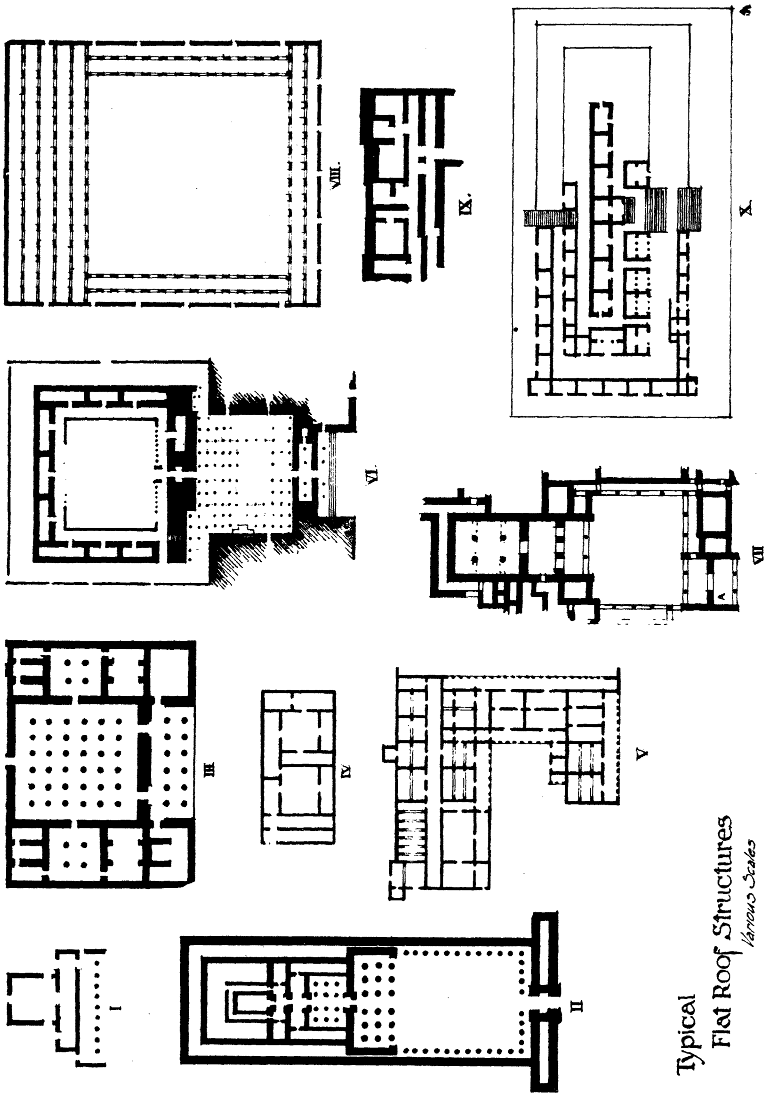

Figure 4.—I, House at Kakoun, Egypt: II, Temple at Edfu, Egypt: III, Palace at Persepolis, Persia: IV, House at Timbuctoo, Africa: V, Monastery at Kalat Sam'an, Syria: VI, Temple at Lhasa, Thibet: VII, Part of Palace, Tiryns, Greece: VIII, Mosque at Cairo, Egypt: IX, Part of Palace, Gha, Greece: X, Palace at Sayil, Yucatan, Three Terraces.

the depth (Fig. 5). But the greater the width, the greater the size required for the girder, or the more numerous the supports required to sustain it; consequently the flat roofed unit is normally nearly square without supports, or transversely elongated like a portico, or is a large square area formed of a series of such porticos, divided by walls or rows of columns, in which case each unit is considerably wider than deep.

The flat roofed construction is strikingly illustrated in the Cretan palaces. Even were it not that the juxtaposition of such a number of various units could hardly have had sloping roofs on account of the difficulty of draining the valleys and pockets which would be formed,[1] the characteristic plan of the units, divided from side to side by walls or rows of columns supporting transverse girders, leaves no room for doubt whatever.[2] The palace of Gha[3] (Fig. 4, IX) is, on a smaller scale, very similar to that of Cnossus. In both cases the main structure consists of two wings at right angles to each other. Each wing was composed in the upper story of a series of approximately square rooms of varying

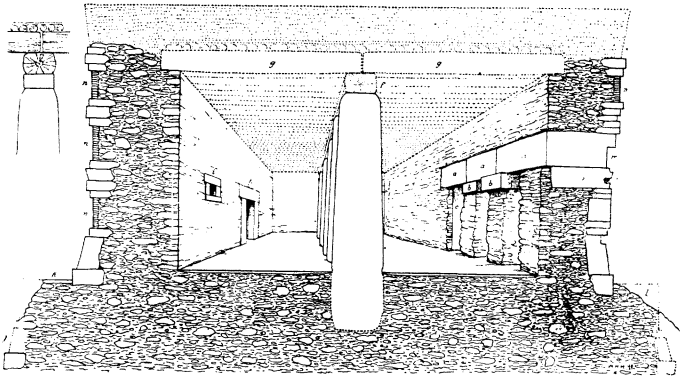

FIGURE 5.—HALL OF THE SIX COLUMNS: MITLA.

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[1] Leroux, *op. cit.* p. 54. Cf. Noack, *Homerische Paläste.* pp. 12 ff., fig. 8.

[2] The corridor-like magazines in the palace of Cnossus are, of course, only basement structures, the great halls above were evidently nearly square, and in one at least the roof was supported by a transverse beam resting on two columns, the foundations of which appear in magazines 7 and 9.

[3] *B. C. H.* XVIII, 1894, pp. 271 ff., pl. XII; de Ridder claims that because no stairs were found, the palace must have been but a single story high. Cf. plan in *A. J. A.* XXIII, 1919, p. 292. There are, however, no stairs in the "pueblos" of our southwest, ladders being used for safety's sake.

sizes opening on a narrow terrace, which in the foundations is shown as a corridor. The double corridor at Gha is an indication that this palace ran up, in certain places at least, to three stories. The effect must have been very similar to our Indian pueblos, and is quite clearly shown on a silver vase from Mycenae.[1] The same arrangement is found in the small rooms against the east wall of the palace enclosure at Tiryns, in a house to the southeast of the grave-ring at Mycenae[2] and in the palace of the third city at Phylakopi[3] in Melos.

The great halls of Tiryns and Mycenae (Fig. 4, VII), however, are quite different in type from those of Crete, as Leroux[4] and Noack[5] have clearly shown. In the first place they are set directly on the ground level instead of being raised upon a terrace platform of basement structures. Again the main room in Greece is considerably deeper in relation to its width than is found in Crete, and the entrance through portico and prodomos with narrow doors, is quite different from the open façades of the island palace halls. But though the plans are different, the methods of construction were undoubtedly the same. Leroux[6] is led by the passages around the smaller *megaron* and across the back of the larger one at Tiryns, to believe that these were covered with sloping roofs, the passages serving to provide drainage space for rain-water. The *megaron* of Mycenae is similarly separated from the walls of surrounding structures, as is also that of Phylakopi. To me it seems probable that at Tiryns the two great one-storied halls were built at a later period than the smaller-roomed multi-storied structures which flank them to the east and west, and that to provide communication between the terraces of these older buildings it was necessary to carry a "chemin de ronde" at mid-height around the back of the great halls. The supposition that these passages were not for roof drainage, is strengthened by the fact that the corridor is carried across the back of the great *megaron,* where it would be quite unnecessary for drainage, while on the other hand, the constructions to the west of the great *megaron* abut directly against its wall. Leroux[7] notices this but dismisses it as unimportant. At Phylakopi the corridor marked (2) which flanks the east wall of the *megaron* is evidently the basement of the terrace on which the upper story rooms to the east opened.[1] And the *megaron* is with little doubt a later structure built directly against the outer terrace wall of the older palace. The isolation of the *megaron* at Mycenae is also easily accounted for on the same hypothesis of later construction. So, while the narrow space (less than 1 m.) between the great halls at Troy may well indicate some sort of sloping roofs, I do not think that the corridors of twice that width in the Mycenaean architecture of Greece do so at all (cf. Fig. 2, VII and Fig. 4, VII). Aside from this the Greek plans clearly denote a flat roof construction, exactly similar to that of Crete. Though the halls as a whole are longer than they are wide, they are broken by transverse divisions—at Tiryns and Mycenae two columns bearing a cross girder, then two walls, then two more rows of two columns each,—into divisions which are roughly twice as wide as they are deep. There is no good reason to doubt that the roof structure was composed of horizontal round beams laid close together, spanning, from front to rear, the spaces between transverse walls and girders, and covered with a thick bed of brush and clay, exactly as depicted in Minoan frescos, as carved on the façade of tombs at Tiryns and Mycenae, and as reproduced in the later architecture of the Lycian tombs.[2]

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[1] Tsountas and Manatt, *The Mycenaean Age,* p. 213, fig. 95.

[2] Schliemann, *Mycenae,* Plan B.

[3] Mackenzie, *Excav. at Phylakopi,* fig. 49.

[4] Leroux, *op. cit.* pp. 103, ff.

[5] Noack, *Ovalhaus und Palast,* pp. 35 ff.

[6] *Op. cit.* pp. 55 ff.

[7] *Op. cit.* p. 56.

The obvious explanation of all these resemblances and differences in plan and construction is that a thoroughly Cretan civilization was responsible for the palaces of Gha and the older terraced structures of Tiryns and Mycenae, and that men of a different race, accustomed to long *megara* opening on the ground level, and to fireplaces, gaining the ascendency in Argolis, ordered great new palace halls to be built and decorated for them by craftsmen of the older régime.[3] The plan would approximate that to which the outlanders were accustomed and which they could easily describe, the construction and decoration would remain like that of Crete.[4] The same difference between theme and workmanship is found in other products of the period, *e.g.* the gold death-mask from Mycenae where a face with a non-Cretan beard is executed by one trained in the Minoan gold-workers' art.[1] It is not impossible that these conquerors were the "fair-haired" Achaeans, and that the halls which they remembered from another land and had reproduced by their conquered workmen, were similar to those of Troy II, perhaps with the barrel roofs. In this connection the resemblance in plan of the Mycenaean propylaea to that of Troy II should be noted; those of Greece presumably had flat roofs, while the Asiatic form, with a deep entrance and no columns between the flanking walls was probably hoop-roofed (Fig. 2, VII B; Fig. 4, VII A); the gateways of Crete are of a definitely different plan. It may be that the prototypes of the *megara* of Argolis were the crude halls of Dimini[2] and Sesklo,[3] whose plans appear to indicate a flat roof of clay on timbers running parallel to the main axis of the building and supported in turn by transverse walls and rows of two columns each. On the other hand though these remains are of the stone-age, that period lasted to such a late date[4] in Thessaly that the *megara* of Dimini and Sesklo are probably later than the second palace of Cnossus, and may themselves be the result of Cretan or even of Mycenaean influence. Such questions of cultural origin and influence cannot be decided with any sureness from the scanty material at hand, but what can be positively stated is that though the arrangements of the great halls are similar, the roof construction of Tiryns was quite different from that of Troy II, but was quite like that in Crete, though here the arrangements are different in plan.

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[1] The fact that this east wing of small intercommunicating rooms has no communication with the exterior, proves that they are only basement structures, entered perhaps by a ladder from the upper story.

[2] Cf. Holland, *A. J. A.* XXI, 1917, pp. 120, 122, and fig. 3.

[3] Cf. Mackenzie, *Phylakopi*, pp. 269–271 for similar change of cultural influence in Melos.

[4] Compare the churches of Barletta and the Cathedrals of Aversa, Acerenza, and Venosa built in southern Italy under the direction of the Normans between

There is a third type of roof construction which partakes of some of the characteristics of each of the foregoing. In this the roof slopes from the centre to either side, as in the hoop roof, but, as in the flat roof, with a median transverse girder supporting the actual roof timbers; the rafters here rest at one end upon this

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1050–1200. The plans are distinctly northern French, the workmanship wholly southern Italian. Cf. Cummings, *Hist. of Arch. in Italy*, II, pp. 37–41.

[1] Schliemann, *Mycenae* (No. 474) Eng. ed. p. 289. This is the opinion of Dussaud, *Les Civilisations préhelléniques*, pp. 283–284.

[2] Tsountas, Προϊστορ. ἀκροπολεῖς, p. 50, fig. 9. Wace-Thompson, *op. cit.* pp. 79 ff., figs. 38 and 39. Leroux, *op. cit.* p. 32, fig. 11.

[3] Tsountas, *ibid.* pp. 89 ff., fig. 18; Wace-Thompson, *ibid.* pp. 65 ff., fig. 34; Leroux, *ibid.* pp. 33–34, fig. 13. The remains here are not sufficiently definite to be sure proof of anything.

[4] *Ann. Arch. Anth.* 1908, pp. 118 ff., 216 ff.

central ridge-pole and at the other upon the tops of the walls, instead of thrusting against them.[1] The rafters are also necessarily straight and rigid. This third type may have developed from the first by the introduction of a supporting ridge under the summit of the hoops (the rod which kept the tops of the hoops properly spaced having been laid *upon* them in the earlier type), or from the second by simply raising the transverse girder somewhat above the front and rear walls it parallels. It may also have developed quite independently of either by the elongation of a round hut with a central post supporting the upper end of rigid rafters, as the tent with two upright poles and a ridge between is developed from the conical tent with a single upright in the centre. Or it may have developed in all of these ways in different localities. The important thing is the influence which such a roof has on the plan of the building it covers.

Like the hoop roof, the roof sloping two ways from a ridge-pole cannot be widened by a multiplication of parallel units, as in the case of the flat roof, because of the difficulty of draining the valleys that would be formed. But like the flat roof borne on girders it cannot be extended greatly in length without intermediate supports for the ridge. Any large structure built on this system must, therefore, be long and narrow, as with the hoop roof, with a median wall or row of columns to uphold the ridge, as with the flat roof borne on girders (Fig. 6).[2] It is possible, of course, to dispense with the obstruction of the central colonnade, by supporting the ridge on transverse girders from wall to wall, provided that the distance between these side walls is not great, but such a construction, beside necessitating a very narrow plan, is much less obvious than that of direct columnar support[3] and can hardly have been as early a form. The idea of placing intermediate supports under the transverse girders themselves and so, by means of a double row of columns, securing considerably greater width, is evidently a still more sophisticated scheme.

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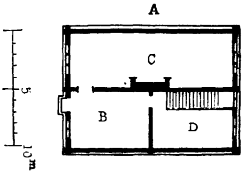
[1] Innocent (*op. cit.* p. 11) does not distinguish between ridge-poles which actually support rafters and those which merely hold them in place. His own Fig. 5, in which a roof of planks is very obviously supported by the ridge, confutes his statement as to the non-sustaining character of this member.

[2] According to Innocent (*op. cit.* p. 17 ff.) the ridge roof supported on axial columns was the earliest form in Denmark, the roof on "crucks" being developed later. These axial posts are still to be found in Denmark, Jutland, the Fünen Isles, Sweden, south Germany, and Switzerland.

[3] Cf. Leroux, *op. cit.* p. 79.



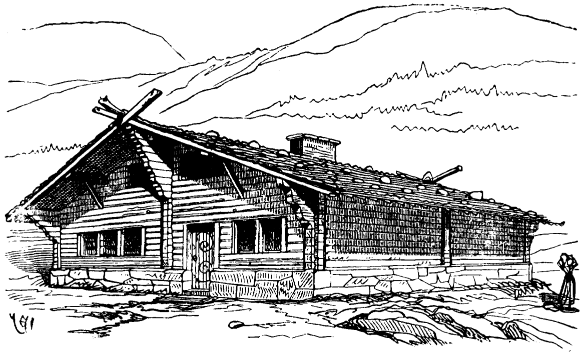


FIGURE 6.—HOUSE WITH RIDGE-ROOF; VOSGES.

The first of these types has been found at Sesklo[1] and at Troy VI,[2] dating presumably from the Mycenaean period; and probably before the eighth century in the temple of Artemis Orthia at Sparta.[3] Later examples are found at Thermos,[4] Locri,[5] Paestum,[6] in the temple of Apollo at Metapontum,[7] in the little temple to the south-east of temple C at Silenus,[8] at Neandria,[9] Eretria,[10] and perhaps Thasos.[11] As Washburn points out,[12] the temple built upon the foundations of the *megaron* at Tiryns[1] was also probably of this type. At Olympia there are two round-ended structures flanking the Bouleuterion[2] which have median rows of columns and date from the sixth to the fifth century, or perhaps are built on even earlier foundations. These curvilinear examples make plausible the theory of Leroux[3] that the rectangular plan developed from a horseshoe-shaped plan for the ridge roof as well as for the hoop roof; in which case the progenitor of the ridge roof would probably be the round hut with a central post to support the peak.

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[1] Tsountas, *op. cit.* pp. 102 ff., pl. III, 24, A, 2.

[2] Dörpfeld, *Troja und Ilion,* I, pp. 170 ff., fig. 63. The foundations of this structure are not at all complete.

[3] *B. S. A.* XIV, pp. 17 ff., figs. 5, 6, 7, pl. I; XVI, p. 26.

[4] Sotiriades, 'Εφ. 'Αρχ. 1900, pp. 161 ff.; *Records of the Past,* I, 1902, pp. 173–181; *Ant. Denk.* II, 5, pl. 49.

[5] Koldewey and Puchstein, *Die Gr. Temp. in Unteritalian u. Sicilien,* p. 3, pl. I.

[6] *Ibid.* p. 17, pl. II.

[7] *Ibid.* p. 39, fig. 38.

[8] *Ibid.* p. 92, fig. 64.

[9] Koldewey, *Berl. Winckelmannsprogramm.* LI, 1891.

[10] *Arch. Anz.* 1911, col. 123.

[11] *C. R. Acad. Insc.* 1912, pp. 212 ff.

[12] *Op. cit.* pp. 44–45. His contention that a single row of interior columns is evidence of a flat roof seems to me quite untenable. It is much more likely that the temple was narrow because the builders knew only how to use a single row, than that only a single row was used because the temple was narrow.

This whole discussion may seem far removed from the question of the origin of the triglyph frieze, but the accurate distinction of roof forms is really of the utmost importance. I think it may be clearly seen from the foregoing:

I. That prehellenic architecture was not of a simple uniform type; Mycenaean roof construction being in no way related to the curvilinear structures of prehistoric Greece, nor to those of Troy II, though practically identical with the southern flat roof construction of Minoan Crete.

II. That the earliest Doric structures (Fig. 7) distinctly indicate a third type of roof, sloping two ways from a ridge pole, which

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[1] Frickenhaus, *Tiryns* I, pp. 2–13, dates this structure as of the seventh century, associating with it a Doric capital found on the acropolis. In a very interesting paper read at Pittsburg, Dec. 1919, Carl W. Blegen of the American School of Athens maintained that this capital had no connection with the foundations, that the latter were built before the earlier foundations of the great megaron had been buried, and were probably decadent work of the end of the Mycenaean period. In support of this he cited the statement that Mycenaean sherds were said to be found "all over the site" at the time of the first excavations. Unfortunately there is no possible way now of verifying this statement or definitely establishing the date of the foundations from the contents of the strata above them. So while I feel certain that the dating of Frickenhaus is much too late, I do not feel that it is impossible for these second foundations to have been built by Dorian conquerors immediately on the ruins of a Mycenaean palace destroyed by them.

Mr. Blegen also showed the plan of a house recently excavated at Corinth, in which a rectangular room entered from its narrow side was divided medially by two columns. This structure was certainly dated as Mycenaean or "Ephyrean" by the pottery found above it. The other houses uncovered near by must have had flat roofs because of their irregular plan, and Mr. Blegen claims that the roof of this one was also flat. The plan certainly suggests a roof sloping two ways, but until the plans of the whole excavation have been examined it would hardly be wise to express an opinion of this particular structure.

[2] *Olympia, Bauwerke*, I. pp. 76 ff., pl. 55; Pfuhl, *Ath. Mitt.* 1905, p. 370.

[3] *Op. cit.* pp. 71–78.

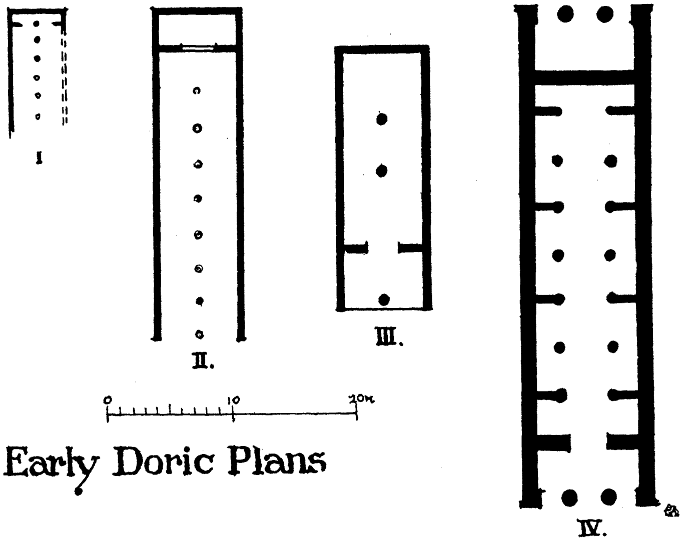

FIGURE 7.—I, TEMPLE OF ARTEMIS ORTHIA, SPARTA, VIII C.: II, OLD TEMPLE AT THERMOS, VIII–VII C.: III, TEMPLE (?) AT TIRYNS, X–VII C.: IV, TEMPLE OF HERA, OLYMPIA, LATE VII C.

had no resemblance to the Mycenaean roof and was without doubt brought in by the Dorian invaders from the north.[1]

It is evident then that Noack's restoration of the Mycenaean roof[2], which Washburn seems to endorse, is correct in that he has made it flat with roof beams running from front to back, but also that his desire to develop primitive triglyphs from the ends of these beams has lead him to give them a size and to space them in a manner altogether unwarranted by any other Minoan construction.

It is also evident that if the Doric roof did not develop from the flat Mycenaean roof, but was from the beginning a sloping construction,[3] neither triglyphs nor metopes could possibly be derived from the ends of roof beams, for, as Washburn implies,[1] only a heavy flat roof could in any way justify such enormous timbers.

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[1] The common practice of giving the name "Megaron" to all large halls in prehellenic ruins, and considering them all indiscriminately the progenitors of the Greek temple, is an exceedingly unscientific proceeding not warranted by the archaeological evidence at hand. Cf. Washburn, *op. cit.* p. 34.

[2] *Jb. Kl. Alt.* I, 1898, pp. 654–668. This reconstruction was made prior to the great excavations in Crete. I have no doubt that with the material which is now at hand Noack would amend his details in many respects.

[3] That this was the case is shown by the fact that the soffit of the horizontal Doric stone cornice is always sloped, while in the Ionic form where the roof was originally flat, the soffit is always horizontal, even though the roof above be

In this connection I should like to point out that even in his own restoration Washburn has not dared to make the layer of clay above the beams as thick as it should be to warrant their great size. In the Lycian tombs where the beams are represented as being in immediate juxtaposition, the layer above is slightly over three times the beam height;[2] in the stone Ionic architecture derived from a similar construction but with the dentils, which represent the beam ends, slightly separated, the corona above is never less than the dentil height;[3] in the drawing which Washburn gives of the church in Cochiti Pueblo[4] the spaces between the beams are at least twice their width yet the layer above is at least twice their height. But in Washburn's Doric reconstruction[5] the beams are separated by less than their own width, and yet the clay covering is less than their own height in thickness. Even this is far heavier than Doric forms would suggest, for there the corona is regularly *less than one-third* the height of the frieze. The change in proportion from a beam supporting a mass two or three times its height to one where the mass is only one-third its height, implies an absolute loss of all sense of the construction involved, quite at variance with the intensely structural appearance of other Doric details.

Washburn has raised two objections to my own suggested reconstruction[6] which I think are easily answered. The first is that the brick piers backing the triglyphs are too frail to stand in a country subject to earthquakes. These piers I have shown as one and a half bricks (or feet) wide, set three and a half bricks on

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sloping, and in the raking cornice of the Doric pediment the cornice is also horizontal. The sloping soffit of the Doric horizontal cornice of the pediment is difficult to explain except on the assumption that this member developed originally on the side of the building and was carried across the front by analogy, which is directly contrary to Washburn's ideas (see p. 339) or on the theory that a roof actually sloped down toward the end of the building as well as toward the sides, as in the Etruscan temples (see below, p. 340 and Fig. 8).

[1] *Op. cit.* p. 47.

[2] Holland, *op. cit.* fig. 3.

[3] On the Caryatid porch of the Erectheum and the choragic monument of Lysicrates the space from the top of the dentils to the top of the corona is slightly more than twice the dentil height.

[4] *Op. cit.* fig. 1, p. 35.

[5] *Ibid.* fig. 8, p. 46.

[6] *A. J. A.* XXI, 1917, pp. 117–158, pl. VII.

centres, and as being ten bricks (2½ feet) high. The thickness might be one, one and a half or two bricks. Now, as Washburn recognizes, a similar construction of brick piers was employed upon the walls of Athens, and was presumably found stable, for it was rebuilt along the original lines. But the size of the piers (he says) is unknown. The restorations of Müller, Choisy, and Caskey[1] all agree in making the piers along the front of the wall two bricks square by ten bricks high and separated by an open space two bricks wide. I see no reason to doubt the essential correctness of these dimensions, though I have given reasons why I think it possible that the width of the piers was even somewhat less.[2] But though these piers are slightly heavier than mine, the pillars on the inner side of the same wall are very much lighter. They are described as being two bricks thick and seven feet apart! They could not well have been more than one brick wide, since they probably centered on the piers on the outer side of the wall which are spanned by eight foot lintels. The height could not possibly have been less than that of a man. If such pillars as these with such spacing were able to resist the earth tremors, I cannot see why those I have suggested should find the slightest difficulty in doing so.

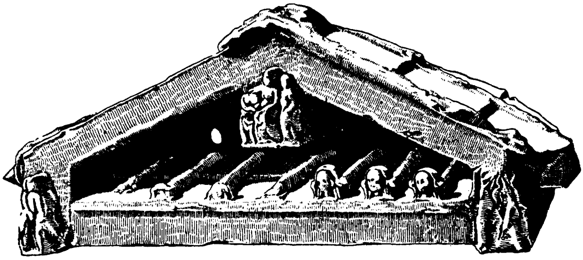

FIGURE 8.—MODEL OF AN ETRUSCAN TEMPLE: NEMI.

His second objection is that my restoration develops the frieze along the side of the temple rather than across the front. I agree with him that the frieze probably appeared on the front of the temple before it appeared on the side, but I should go further and say that it crowned a solid front *wall* long before it appeared above the columns of a portico.[1] For as Guadet[2] keenly points out, the use of a wooden cap (the taenia and regulae) upon a wooden architrave is wholly absurd from any constructional point of view.[3] And even before the frieze appeared on the temple face, it was probably used as a cap to other fortified walls. It is such a wall that I have intended to represent, an abstract wall, not any particular part of a temple whatever. Nevertheless, my drawing might represent the front wall of a primitive temple as well as a side wall. It is true that in classic stone construction the horizontal cornice across the front is not the edge of an actual roof, but there is at least a suggestion that it represents a primitive construction like that shown in the Etruscan temple models from Nemi and Satricum[4] where the roof of the portico slopes forward to the horizontal cornice, under the main roof sloping to the sides (Fig. 8).

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[1] Caskey, *A. J. A.* XIV, 1910, pp. 298–309, gives a list of other restorations and a discussion of those mentioned here.

[2] *Op. cit.* p. 156.

LEICESTER B. HOLLAND.

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[1] It is not at all impossible that the temples at Orchomenos (Bulle, *Orchomenos*, I, p. 94; pl. III) and Sparta (*B. S. A.* XIII, pl. 2) were neither *prostyle* nor *in antis* but rather had a front wall opening into the pronaos by a door, or by two doors if the cella was divided by a median row of columns. Cf. the old temple of Locri in its first state (Koldewey and Puchstein, *op. cit.* I, pp. 2 ff., fig. 3).

[2] *Elements et Théorie de l'Architecture,* I, pp. 342 ff.

[3] In Choisy's reconstruction (*Histoire de l'architecture,* I, pp. 287 ff.) he could evidently find no reasonable structural excuse for a *taenia* upon a wooden architrave; wherefore he omits it altogether from the wood combination, though he shows it in the derived stone form.

[4] Rizzo, *B. Com. Rom.* XXXVIII, 1910, pp. 281 ff.